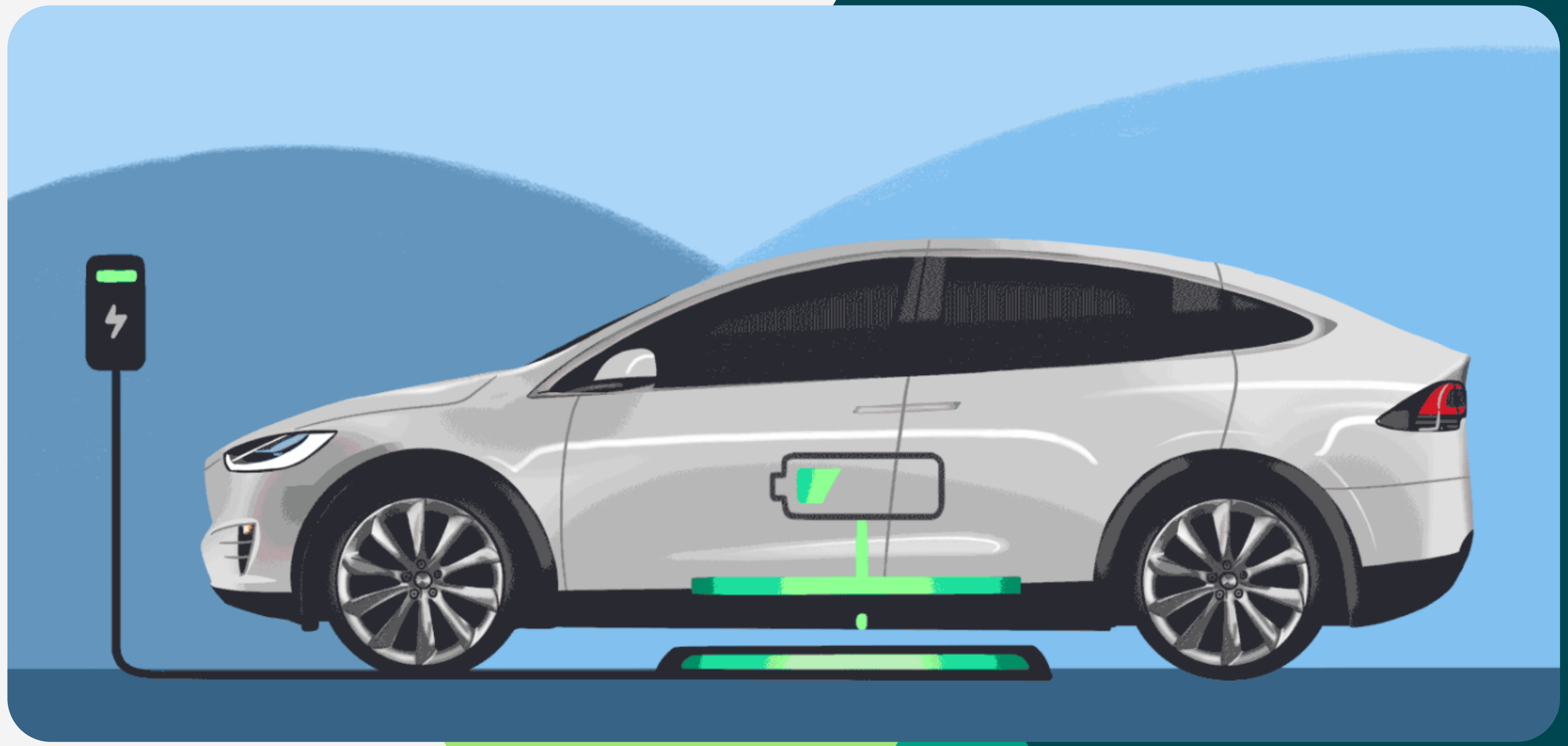
IoT-Based Wireless EV Charging System For Electric Vehicle

AGENDA

- Introduction
- Problem Statement
- Objective
- AIM
- Software specification
- Software Implementation Steps
- Hardware specification
- Methodology
- Design & Implementation Of Proposed System
- Advantages
- Application
- Conclusion

INTRODUCTION

- Wireless power transfer technology offers a revolutionary alternative to traditional wired infrastructure, reducing reliance on metals like copper and aluminum.
- This sustainable approach addresses challenges such as hazards and inconvenience. In the realm of autonomous vehicle fleets, wireless charging becomes crucial, enhancing efficiency and autonomy.
- This presentation focuses on magnetic resonance-based wireless power transfer for electric vehicle charging, providing performance data and addressing standardization and remaining challenges. It aims to contribute to sustainable energy transmission solutions.



PROBLEM STATEMENT

The necessity for effective and practical charging infrastructure has arisen from the explosive expansion of electric cars (EVs) in recent years. Conventional plug-in charging techniques have drawbacks in terms of physical connector wear and tear, possible safety risks, and user convenience. Inductive power coil-based wireless charging systems have surfaced as a viable remedy for these issues. Nevertheless, there are a number of issues that need to be resolved when integrating Internet of Things (IoT) capabilities with inductive power coil-based wireless EV charging systems

OBJECTIVE

- To create a charging station capable of accommodating two electric vehicles simultaneously, thereby increasing charging capacity and efficiency to meet the growing demand for electric vehicle charging infrastructure.

- To integrate a user-friendly mobile application interface that allows users to remotely monitor, manage, and schedule charging sessions, providing convenience and flexibility while ensuring optimal utilization of charging resources.

- To implement power-saving mechanisms within the charging station, such as intelligent power management and scheduling algorithms, aimed at optimizing energy consumption and reducing environmental impact during the charging process.

AIM

- Explore the use of wireless power transfer for charging electric vehicles, highlighting its departure from conventional cable infrastructure.

- Assess the performance of magnetic resonance-based wireless power transfer systems and ongoing standardization efforts.

- Identify and tackle efficiency, safety, interoperability, and regulatory concerns hindering widespread adoption, offering practical solutions.

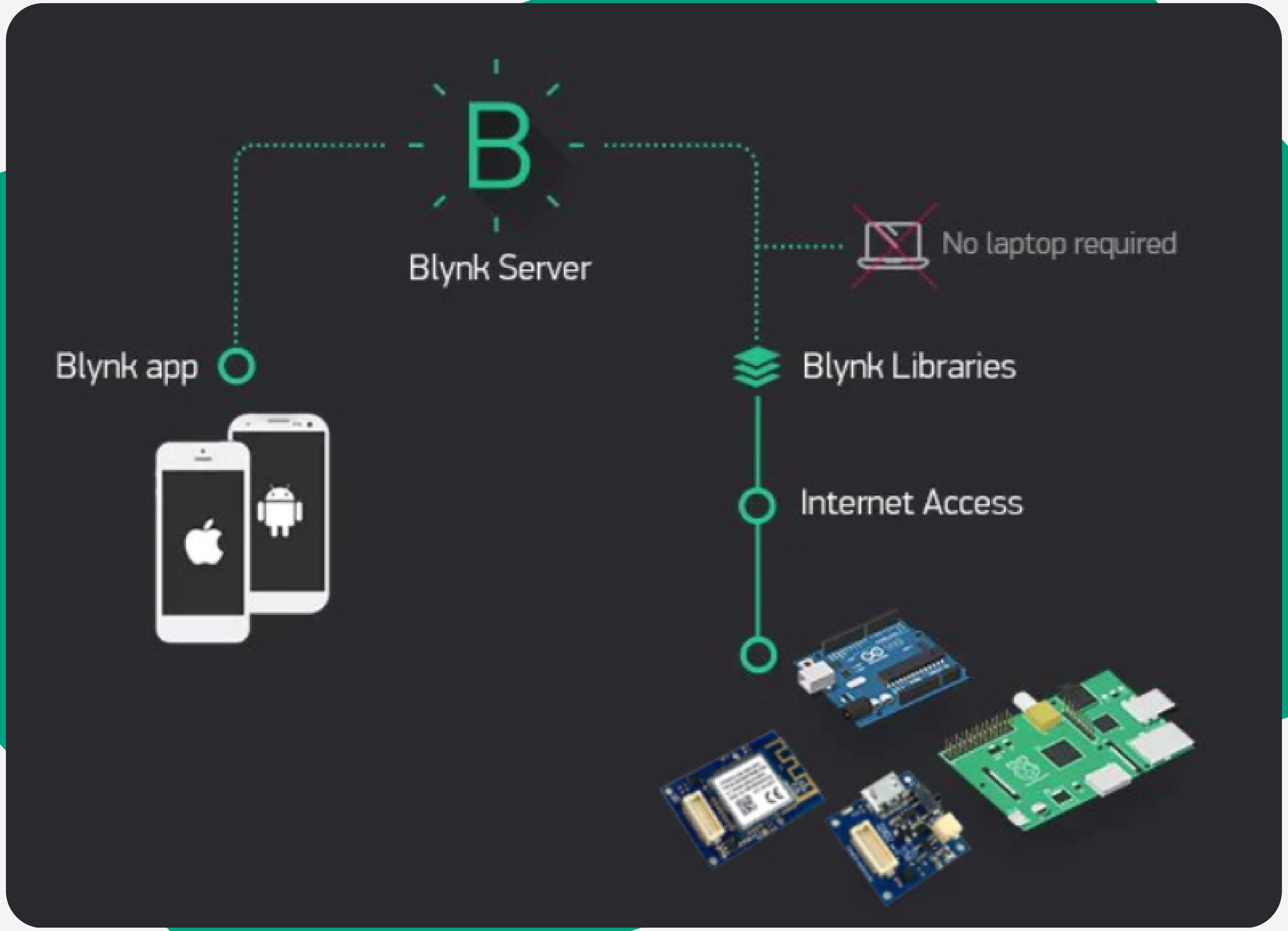
- Emphasize how wireless power transfer reduces reliance on limited resources like copper and aluminum, promoting resource efficiency in energy transmission.

- Investigate integrating wireless EV charging systems with IoT capabilities for seamless integration, enabling automated charging, real-time monitoring, and optimization.

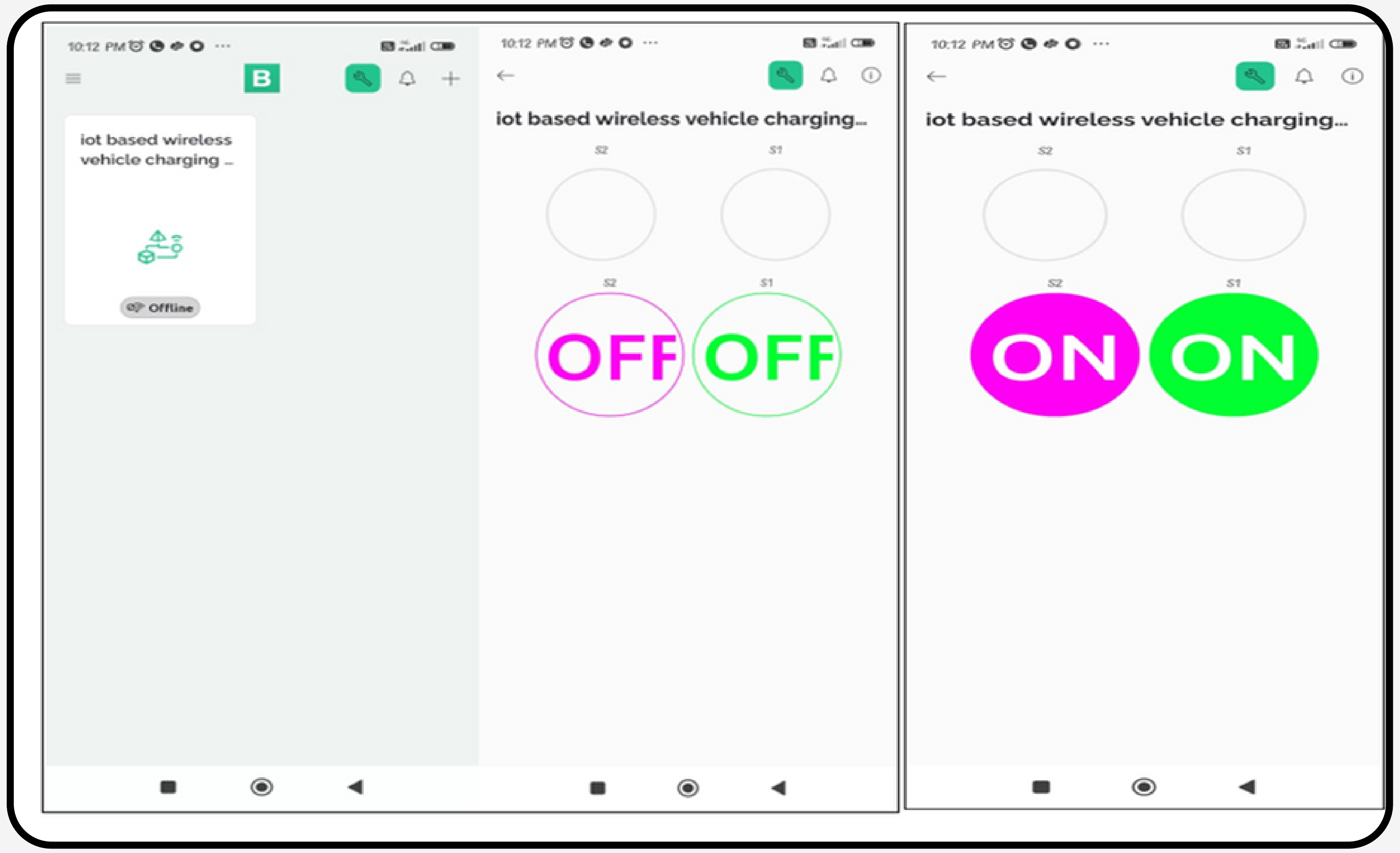
SOFTWARE SPECIFICATION

1. **Arduino IDE:**
Specifications:
Legacy IDE(1.8.X)- Arduino IDE(1.8.19)

2. **Blynk App:**
Specifications:
Blynk IOT App- Version:2.27.3



SOFTWARE IMPLEMENTATION STEPS:



Step 1: Set Up Blynk Account and Project:

Step 2:Install Blynk Library in Arduino IDE:

Step 3:Hardware Connection:

Step 4:Write Arduino Sketch:

Step 5:Define Blynk Authentication Token:

Step 6:Set Up Virtual Pins:

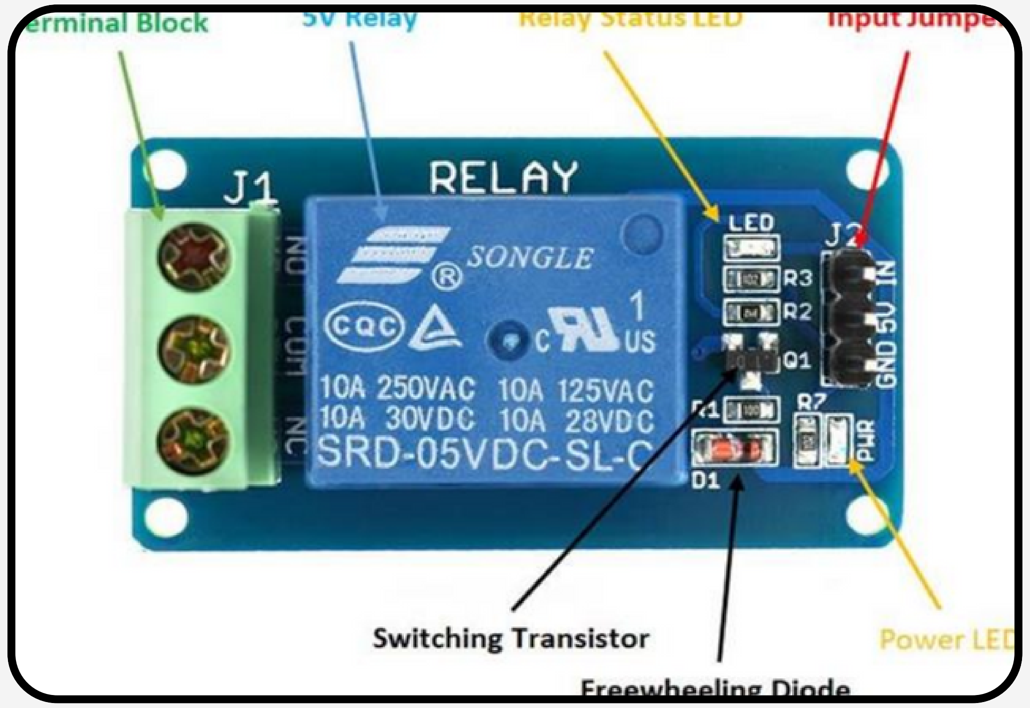
Step 7:Write Code for Interfacing with Blynk App:

Step 8:Test Communication with Blynk App:

Step 10:Documentation and Deployment:

HARDWARE SPECIFICATION

1. Relay Module

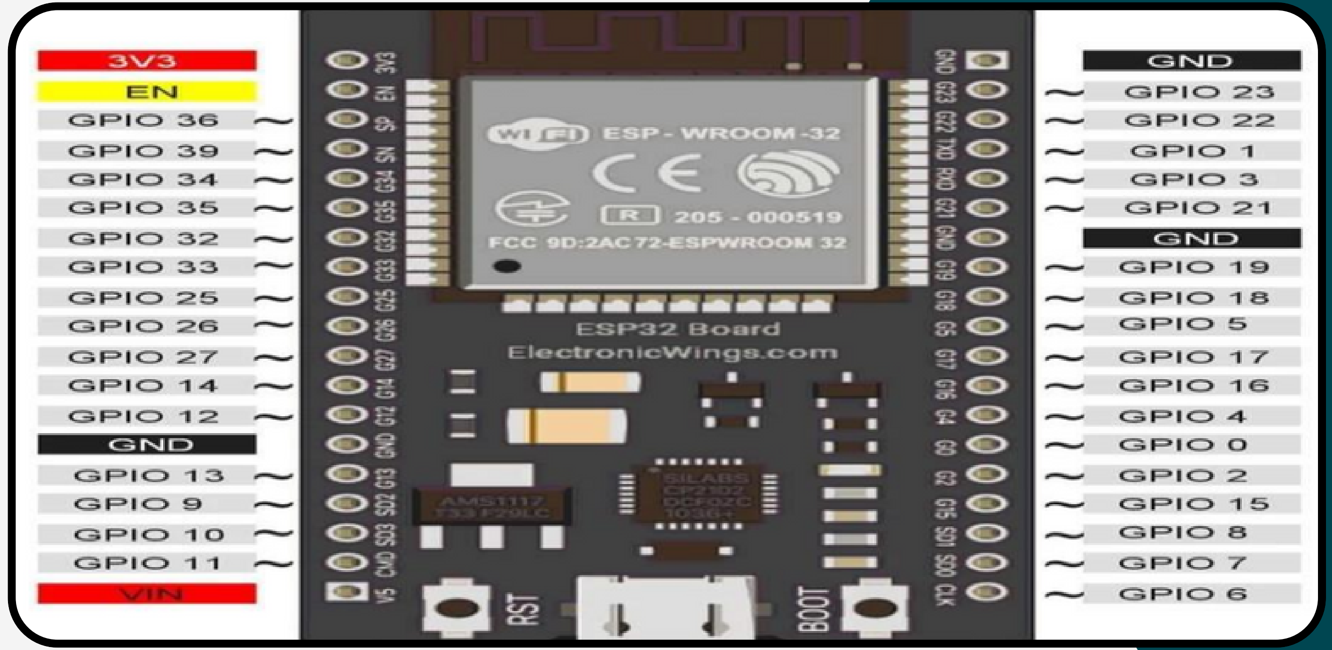


1. Normal voltage: 5V DC
2. Normal current: 70mA
3. Maximum load current: 10A/250V AC, 10A/30V DC
4. Maximum switch voltage: 250V AC, 30V DC
5. Operate time: ⩽ 10ms
6. Release time: ⩽ 5m

HARDWARE SPECIFICATION

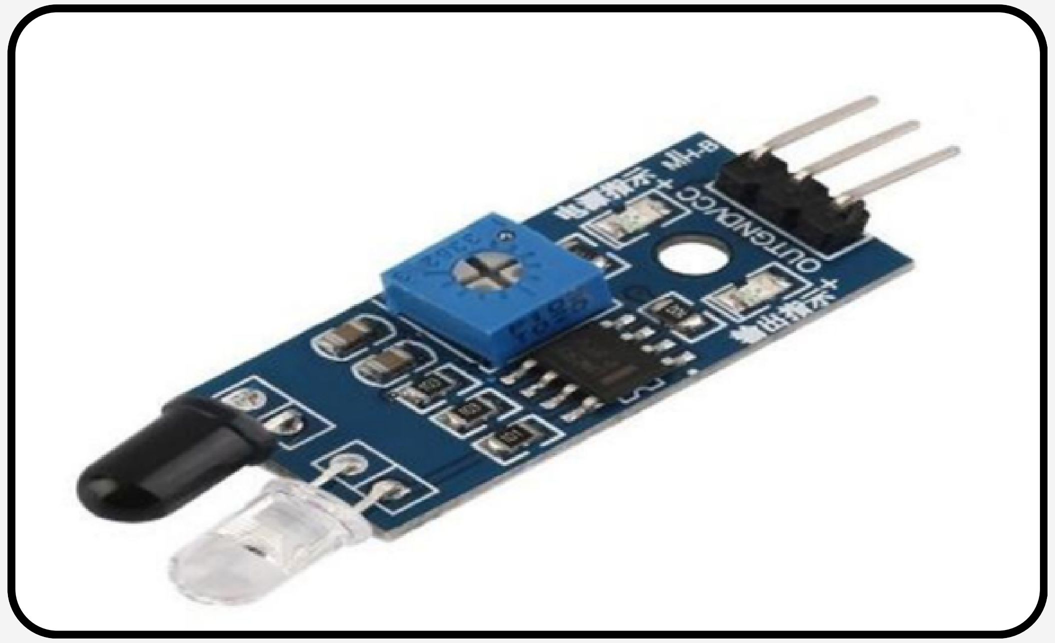
2. ESP32

- Single or Dual-Core 32-bit LX6 Microprocessor with clock frequency up to 240 MHz.
- 520 KB of SRAM, 448 KB of ROM and 16 KB of RTC SRAM.
- Supports 802.11 b/g/n Wi-Fi connectivity with speeds up to 150 Mbps.
- Support for both Classic Bluetooth v4.2 and BLE specifications.
- 34 Programmable GPIOs.
- Up to 18 channels of 12-bit SAR ADC and 2 channels of 8-bit DAC
- Serial Connectivity includes 4 x SPI, 2 x I2C, 2 x I2S, 3 x UART.
- Ethernet MAC for physical LAN Communication (requires external PHY).
- Host controller for SD/SDIO/MMC and 1 Slave controller for SDIO/SPI.
- Motor PWM and up to 16-channels of LED PWM.
- Secure Boot and Flash Encryption.
- Cryptographic Hardware Acceleration for AES, Hash (SHA-2), RSA, ECC and RNG



HARDWARE SPECIFICATION

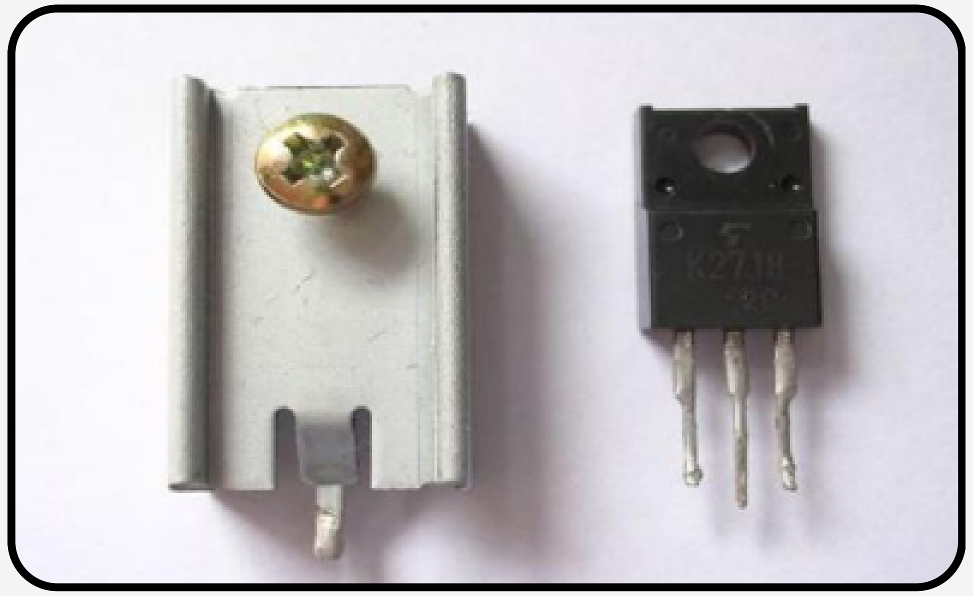
3. IR Sensors



- Board Size : 3.2 x 1.4cm
- Working voltage : 3.3 to 5V DC
- Operating voltage : 3.3V: ~23 mA, to 5V: ~43 mA
- Detection range : 2cm – 30cm (Adjustable using potentiometer)
- Active output level The output is “0” (Low) when an obstacle is detected

HARDWARE SPECIFICATION

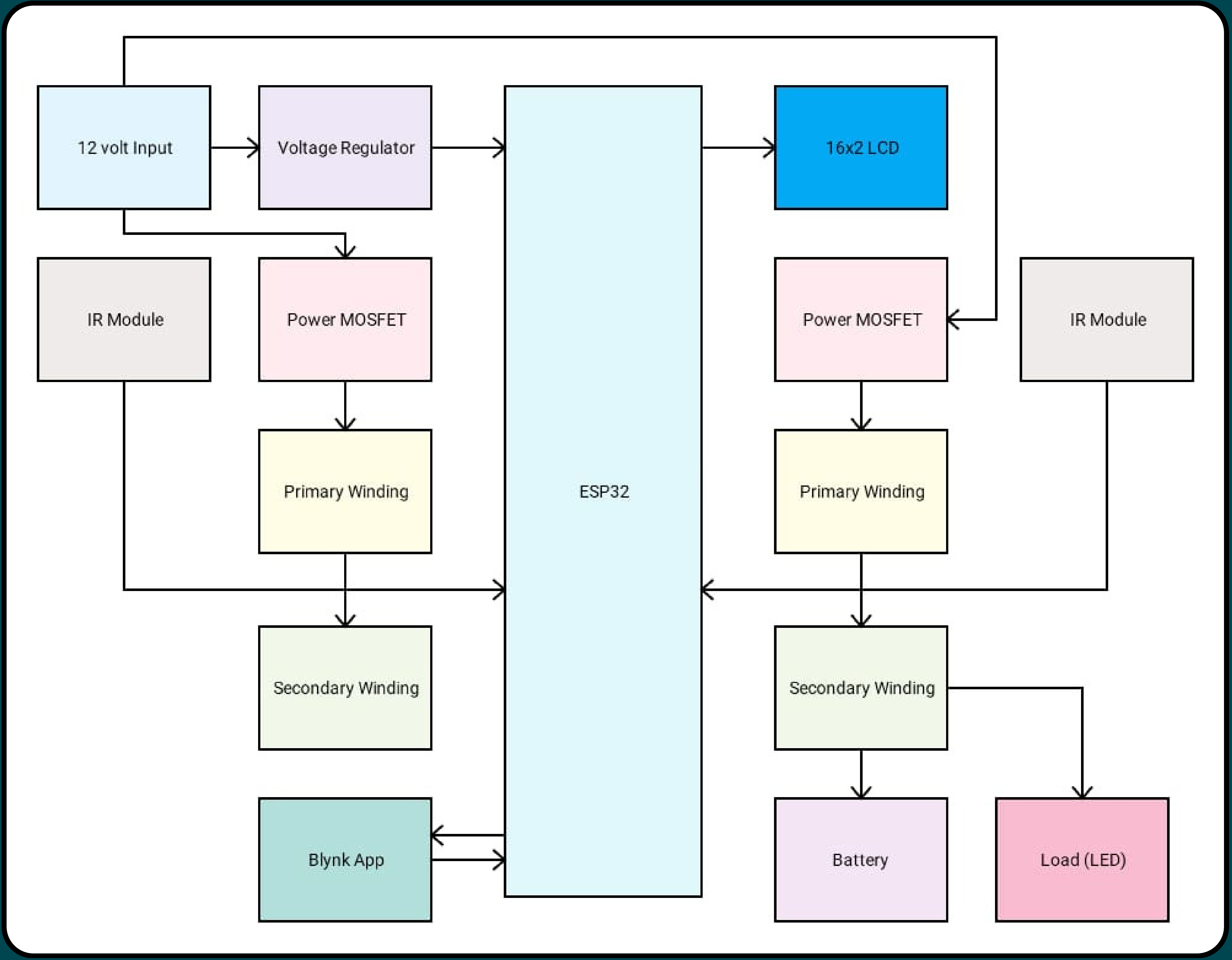
4. MOSFET



1. Small signal N-Channel MOSFET
2. Continuous Drain Current (ID) is 49A at 25°C
3. Pulsed Drain Current (ID-peak) is 160A
4. Minimum Gate threshold voltage (VGS-th) is 2V
5. Maximum Gate threshold voltage (VGS-th) is 4V
6. Gate-Source Voltage is (VGS) is ±20V (max)
7. Maximum Drain-Source Voltage (VDS) is 55V
8. Rise time and fall time are about 60ns and 45ns respectively.
9. It is commonly used with Arduino, due to its low threshold current.
10. Available in To-220 package

METHODOLOGY

Block Diagram :



METHODOLOGY

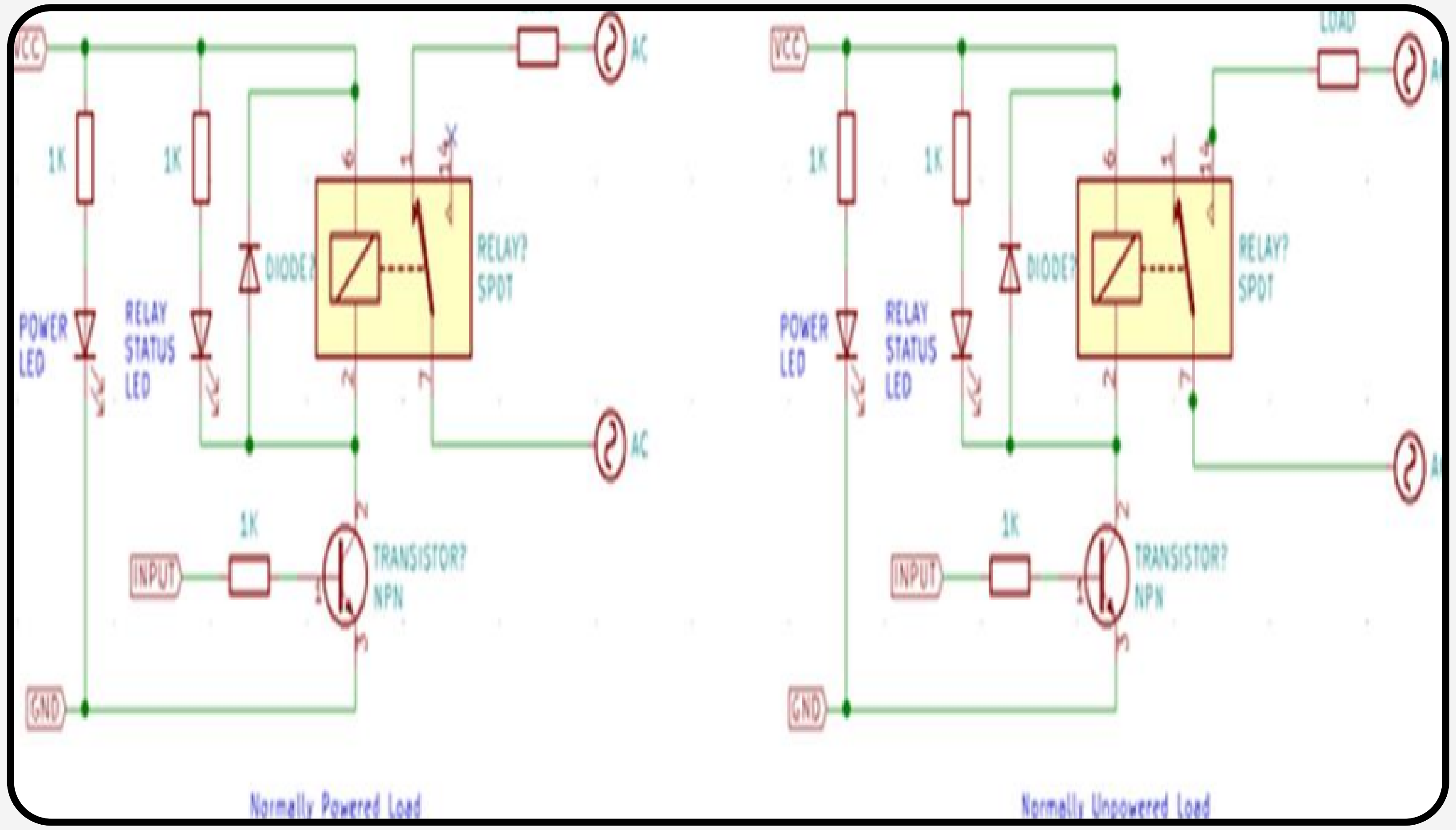
Explanation :

- The wireless charging process for electric vehicles begins with the vehicle parking over a designated charging slot equipped with wireless charging technology.
- Underneath this parking area, coils are strategically installed to generate an alternating magnetic field, which serves as the conduit for wireless charging. Simultaneously, the electric vehicle itself is outfitted with coils that align with those beneath the charging spot.
- When the vehicle parks over the designated spot, these coils synchronize with those of the wireless charger, ensuring efficient energy transfer.
- Once aligned, high-frequency electricity is transmitted through the wireless charging station, creating alternating magnetic fields in the vicinity of the coils installed beneath the parking spot.
- These alternating magnetic fields induce electricity in the coils integrated within the electric vehicle, initiating the transfer of electrical energy from the charging station to the vehicle. Subsequently, the induced electricity undergoes conversion into direct current (DC) using a rectifier, or an AC-DC converter, to align with the vehicle's battery requirements.
- This converted DC electricity is then directed towards the vehicle's battery, where it is utilized to charge the battery.
- Through this process, the energy stored in the battery is replenished, ensuring that the electric vehicle remains powered and ready for operation. Overall, the block diagram illustrates a comprehensive and efficient method of wireless charging for electric vehicles, emphasizing the seamless interaction between the charging station and the vehicle to facilitate cable free and convenient charging.

METHODOLOGY

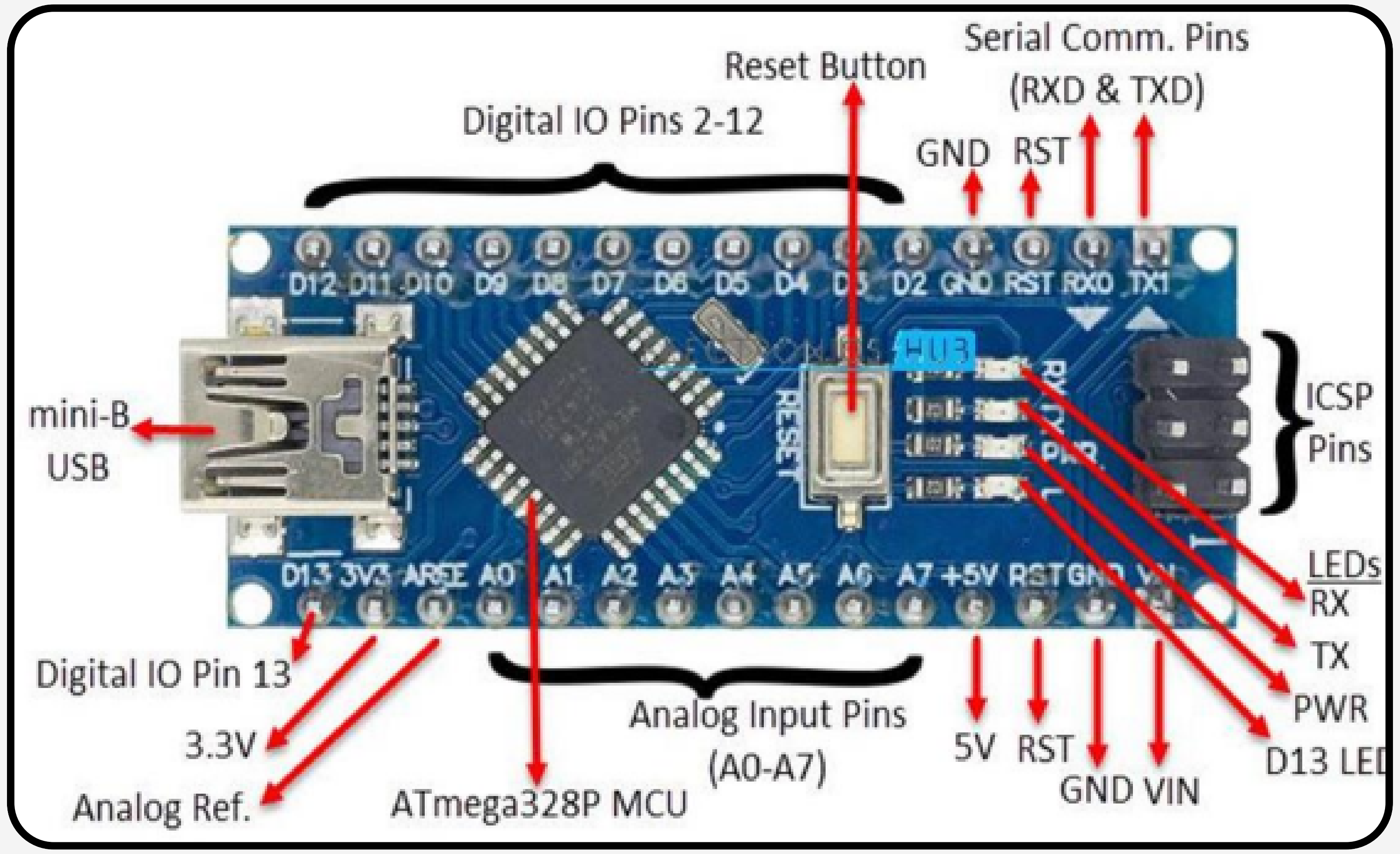
Arduino Nano

- A relay is a controlled device used to switch electrically operated components on and off. It consists of input and output terminals, which can be controlled by a single or multiple signals. It can have various types of contacts: make, break, or combination.
- Relays can be used to control circuits with low pass signals or to repeat signals over long distances. Components on a 5V single-channel relay module include the relay itself, a transistor, diode, LEDs, resistors, male header pins, and a screw-type terminal connector.
- To use the module, connect one terminal of the load to the common pin and the other to either the normally open (NO) or normally closed (NC) pin depending on whether you want the load to be connected or disconnected when the relay is active



METHODOLOGY

Relay Module

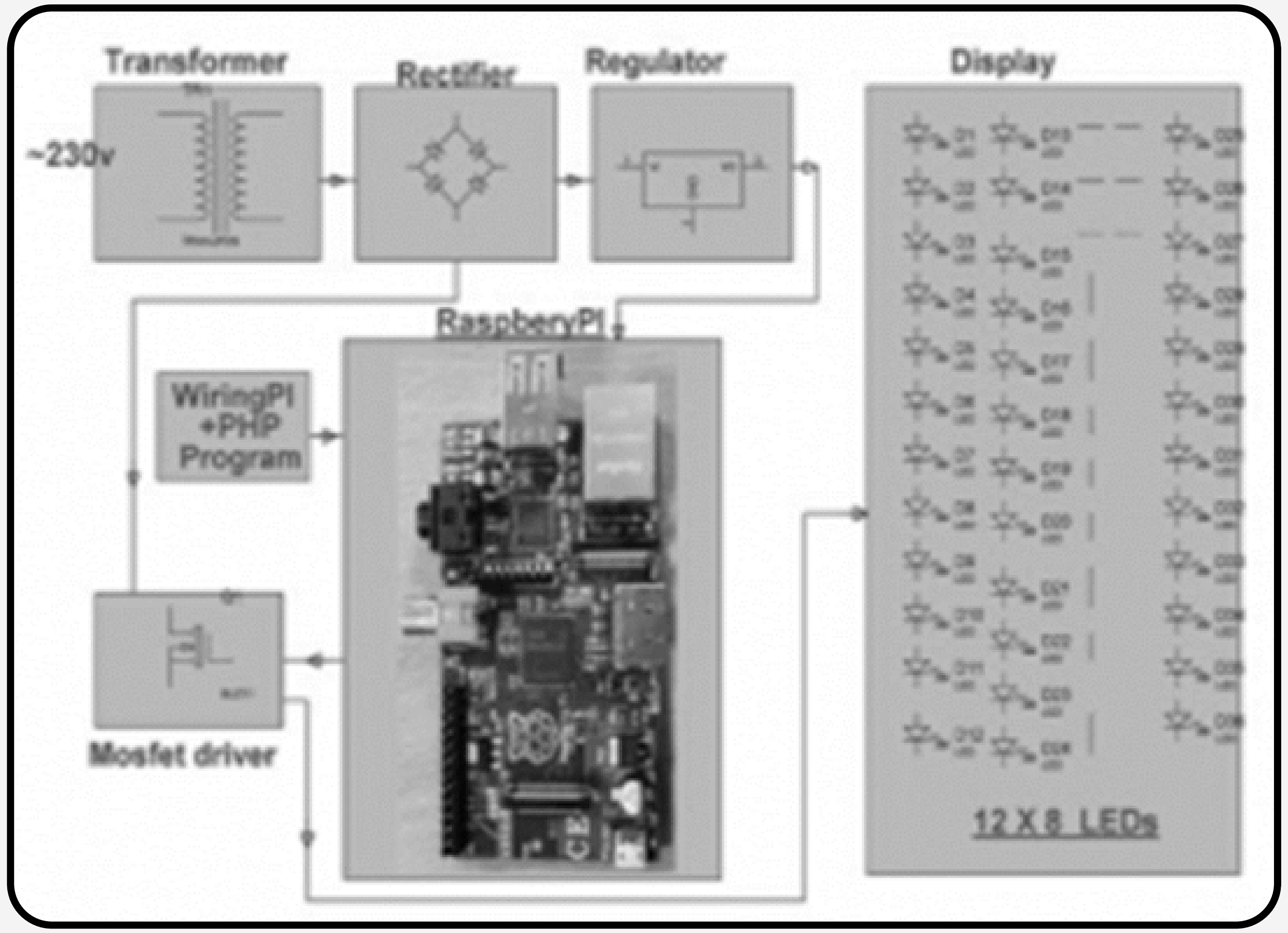


- The Arduino Nano, programmed via the Arduino IDE, can read analog and digital input signals from sensors, control motors, and switch LEDs on and off.
- It features an ATmega328 main microcontroller, USB power, voltage regulator, crystal oscillator, various voltage pins (3.3V, 5V, GND, Vin), analog pins (A0 to A5), power LED indicator, TX/RX LEDs, digital I/O pins, AREF pin, and reset button.
- The board includes an on-board LED on digital pin 13 for basic operations. It can be programmed via USB or In-Circuit Serial Programming (ICSP), with options for configuring external interrupts on certain pins.

METHODOLOGY

MOSFET

- The MOSFET, or metal–oxide–semiconductor field-effect transistor, operates by controlling voltage and current flow between its source and drain terminals. It acts like a switch, based on the principle of the MOS capacitor.
- By applying a positive or negative gate voltage, the conductivity of the device can be controlled. When a positive gate voltage is applied, a channel forms beneath the oxide layer, allowing current flow.
- Conversely, a negative gate voltage creates a channel as well.
- MOSFETs are commonly used as switches, such as in automatic brightness control for street lights. By integrating with microprocessors, they enable efficient control of lighting systems, for example, switching between high-intensity discharge lamps and LEDs based on brightness requirements.



DESIGN & IMPLEMENTATION OF PROPOSED SYSTEM

Circuit Diagram:

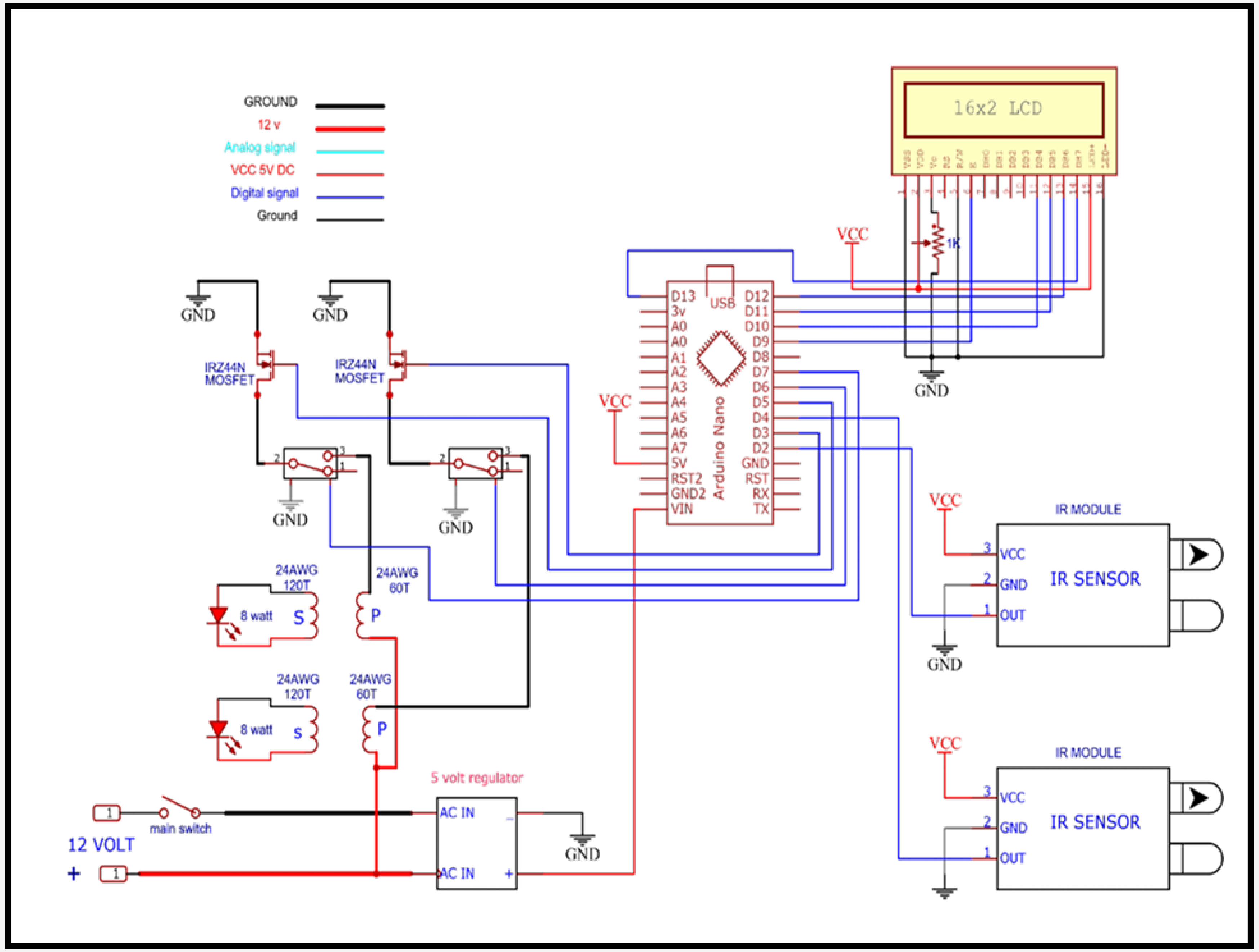


Fig: Circuit Diagram Of Wireless EV Charging System for Electric Vehicle

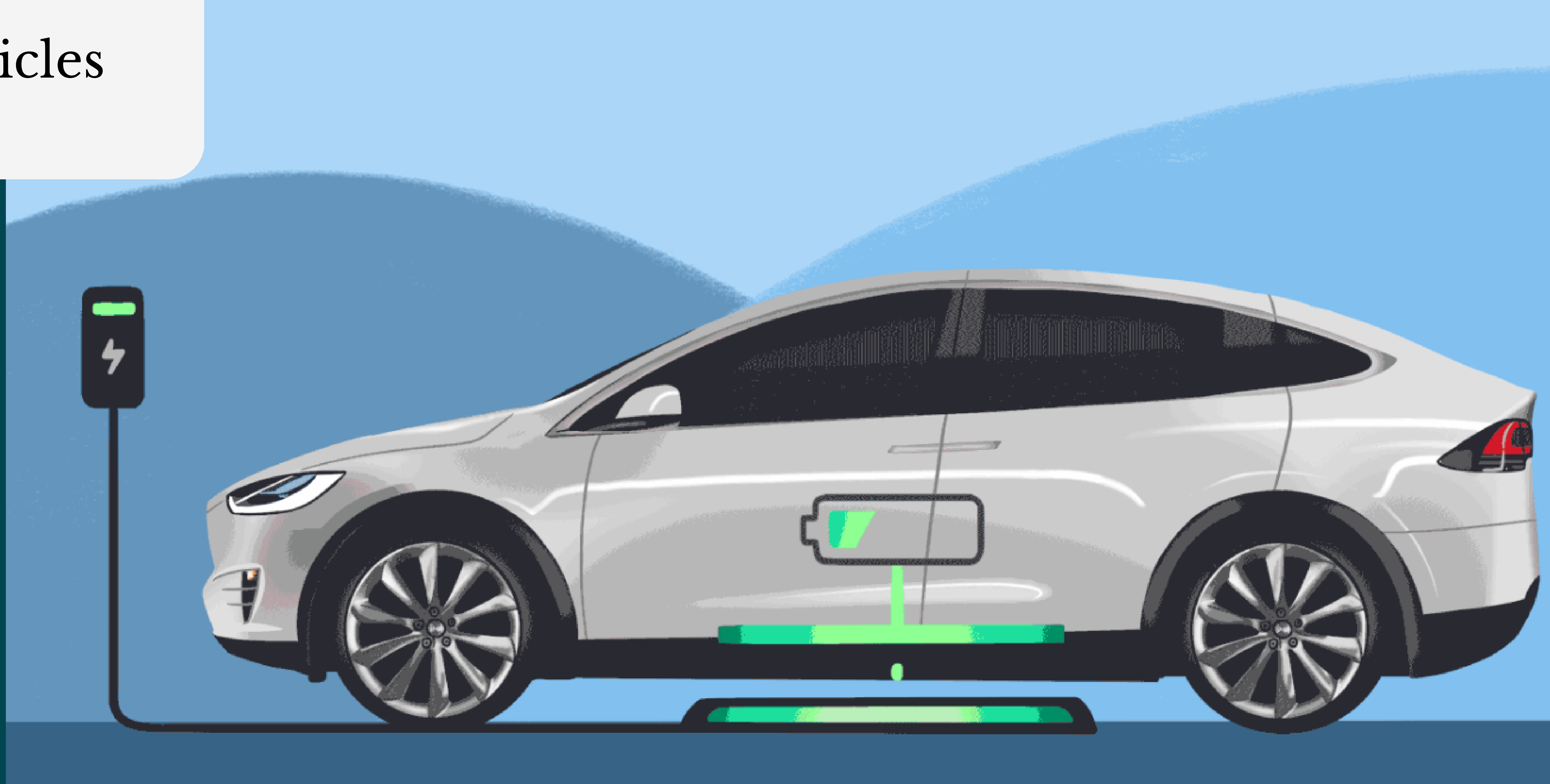
DESIGN & IMPLEMENTATION OF PROPOSED SYSTEM

Explanation :

- Figure shows the circuit diagram of an electric vehicle charging system.
- The main part or the heart of the system is the microcontroller which controls the functions of the devices connected according to the requirement.
- Using the Arduino uno processor the proposed system is implemented with programming written in Embedded C.
- The figure shows the different sensors used in the system.
- Current sensor is used to measure the amount of current in a wire and generates a signal which is directly proportional to the current.
- The output signal is used to display the measured current using an ammeter, or can be utilized for further analysis.
- Another important sensor is the Voltage Sensor which is mainly used to convert voltage measured into a physical signal and it is directly proportional to the voltage.
- Connection V is a physical signal port that outputs the measurement result.
- The specialty is, it will measure the presence of a voltage without making metal contact.
- It is made of resistive voltage divider and integrated resistors, embedded in a casted resin, which has very low inductance. The whole arrangement is in the shape of zigzag, together with the resin permittivity which acts as a capacitance
- Arduino uno, OLED and node MCU.

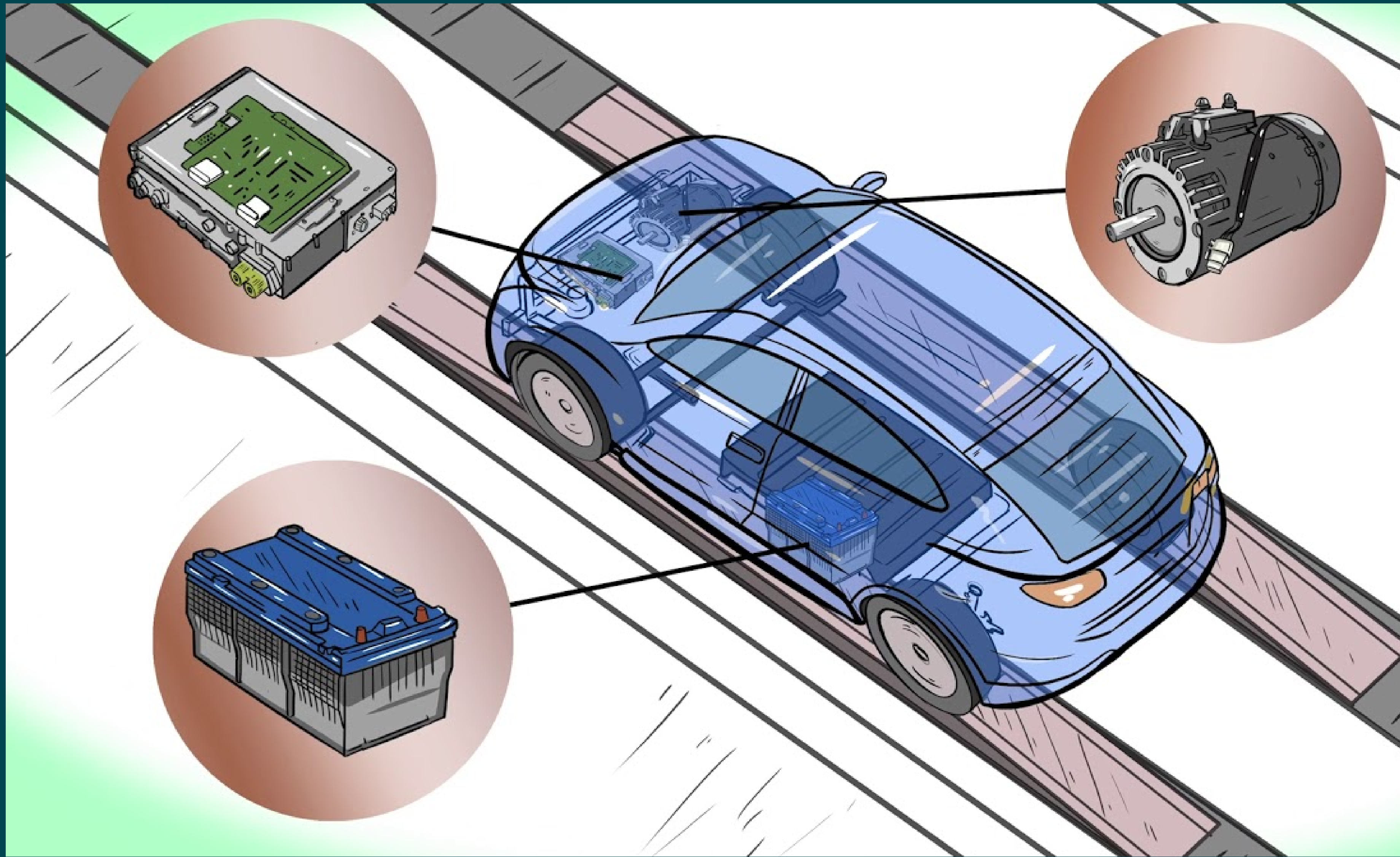
ADVANTAGES

- Corrosion Preventions
- Reduced Wear and Tear
- Infection Risk Reduction
- Driving Range Expansion
- Durability for Self-Driving Cars
- Dynamic Charging for Moving Vehicles



APPLICATION

- Electric Vehicle Charging Infrastructure
- Transportation Industry
- Consumer Electronics
- Healthcare Sector
- Industrial Automation
- Renewable Energy Integration
- Military Applications
- Maritime Industry



CONCLUSION

- In conclusion, wireless charging eliminates the need for bulky wires and plug points, making it a straightforward and cutting-edge way to charge electric cars (EVs). demonstrating the effectiveness and usefulness of this technology, when the EV is parked above the wireless charger, electricity is created in the coil located at the bottom of the vehicle by mutual induction. Additionally, the expansion of wireless charging to allow charging while driving signifies a substantial development in EV charging capabilities, offering users increased convenience and flexibility. With implications for the future of transportation infrastructure, this evolution highlights the ongoing innovation in the field of wireless power transfer.
- This report envisions future technologies like RFID tag payment and self-service entry and exit gates, highlighting the potential of wireless charging systems to change EV charging stations. The aforementioned enhancements are intended to optimize workflow, reduce traffic, and improve the overall user experience at charging stations. All things considered, the investigation of wireless charging technology in this work makes a significant addition to the area by providing insights into its effectiveness, use, and possible future advancements. As wireless charging develops further, it has the potential to completely disrupt not just the transportation sector but also a number of other industries, such as consumer electronics, healthcare, and industrial automation, thereby establishing itself as a game-changing technological advancement.

Do you have any questions?

THANK YOU